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COMPARISON COSTS - SUPPLEMENT TO ROUTINGS EAST & WEST CUSTER-PRAIRIE CO. LINE

ENGINEERING REPORT
FOR
COMPARISON OF COSTS
ON THE
SUPPLEMENT
TO
INTERSTATE HIGHWAY ROUTINGS EAST AND WEST OF THE CUSTER-PRAIRIE COUNTY LINE

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DECEMBER 11, 1964

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SUPPLEMENT TO THE
CUSTER-PRAIRIE COUNTY LINE
EAST & WEST ENGINEERING REPORT

December 11, 1964

FOREWORD

A report was published under the date of November 10, 1959 comparing the relative merits of two proposed routings of Interstate 94, east and west of the Custer-Prairie County line. The report considered the following costs for each proposal:

1. Construction Costs
2. Maintenance Costs
3. Operating Costs

The conclusions of the report showed Line "A" to cost $482,667 less than Line "B", and the operating costs to favor Line "A" by $149,300 over a twenty year period. The Maintenance costs were considered equal on the two routes. Line "A" was proposed as the more favorable location based on the above conclusions.

The need for this supplement was brought about by two factors: a change in the design year from 1975 to twenty years from the time of construction and a change in location of the Interstate east of the Powder River.

The change in design year from 1975 to 1988 increased the design hourly volume from 360 vehicles per hour to 570 vehicles per hour. This increase means that the at-grade approaches used in the 1959 report are no longer allowable and that access will have to be provided by other means. Interstate standards do not permit the use of at-grade approaches where the mainline traffic exceeds 500 DHV.

On March 24, 1964, the Highway Commission approved the Terry East and West Route Report. This report proposed three alternate routings from a point immediately west of the Powder River to a point approximately three miles east of Terry. The Highway Commission approved the proposed B Line and the Bureau of Public Roads concurred with them. The B Line passes to the south of the routing established in the 108d and 104b reports from the Powder River to Terry. The change in routing east of the Powder River dictated that a re-analysis be made of Line "B", because a potential shortening could be made from a point near Station 600±, west of the Powder River, to a tie with the Terry E & W B Line east of the Powder River.

This supplement has been prepared to reflect the effect of the change in design year on lines "A" & "B", and to evaluate the revision of Line "B" from a point near Station 600± easterly to a tie with the Terry E & W B Line at B Line Station 1237+75. The revision has been designated Line "B-1" and will be referred to as such in this supplement.

Lines A & B have been extended on the Terry E & W B Line to a common point with alternate "B-1" east of the Powder River.

ROUTE DESCRIPTIONS

The description of the routes presented in the 1959 report are still generally applicable with the following exceptions:

LINE "A"

Line "A" parallels present US 10 from a point near Station 195± to Station 217± instead of crossing present US 10 in the vicinity of the former Blatchford cattle pens. Line "A" diverges from present US 10 at the equation 217+35bk. equals 1000+00 ah. and ties into the Terry E & W B Line at Station 1094+85. The "A" Line is then common with the Terry E & W B Line from this point to the East Common Point at Station 1237+75.

Access through the valley cannot be provided by the use of the at-grade approaches that were allowable at the time the 1959 report was prepared. Access to abutting land will have to be provided from Present US 10 left in place as a north frontage road.

Access to present US 10 at the west end of the valley will be by means of an interchange near the West Common Point.

LINE "B"

Line "B" remains unchanged to a point near the Powder River. At this point it ties into the Terry E & W B Line at the equation 762+22 bk. equals 1094+85 ah. and is common with Line A, on the Terry E & W B Line, to the East Common Point at Station 1237+75.

Access is provided by means of present US 10 left in place as a north frontage road. Access to present US 10 at the West end of the valley will be by an Interchange near the West Common Point. The Interchange provided near the east end of the 1959 study area has been eliminated, due to the previously mentioned change in alignment east of the Powder River.

LINE "B-1"

Line "B-1" diverges from Line "B" at approximately Line "B" Station 616+00. It crosses the Powder River approximately 3000 feet upstream from the revised common crossing of Lines "A" & "B". Line "B-1" continues easterly for approximately 2.4 miles where it ties into the Terry E & W B Line at the East Common Point. The East Common Point is at the equation 895+00 bk. equals 1237+75 ah. Line "B-1" traverses rougher terrain than Line "B" as is reflected by its higher cost. The Line "B-1" crossing of the Powder River is also more costly, due to the need for channel alterations.

CONSIDERATIONS

The same considerations reported in the 1959 report will be included in this supplement. The considerations presented in the 1959 report were:

1. Construction Costs
2. Maintenance Costs
3. Operating Costs
4. Service to the Highway User

CONSTRUCTION COSTS

The construction costs of the three alternates evaluated in this supplement have been amortized to reduce them to a yearly basis. A six percent capital recovery factor has been applied to each construction item in accordance with its service life. A table amortizing the 1959 costs has also been prepared to facilitate a comparison between the two reports.

The following item by item discussion is made to correlate the two reports.

Right of Way

The Right of Way costs presented in the 1959 report represented the cash compensation to property owners. The costs of Stock and Machine passes were included in the costs for sub-base construction. The cost of private access facilities should be charged to Right of Way. The Right of Way costs prepared for this supplement include the costs for private access facilities. A composite Right of Way life has been determined for proper amortization of these costs. It is felt that this method of presentation will also illustrate the increased costs to the Line "A", because of the change in design year.

Private access facilities have been shown in this supplement west of the Powder River. Private access facilities are not normally included in route reports but have been included in this supplement because

1. Private access was shown in the 1959 report
2. One of the objectives of this report is to evaluate the changes in access

Structures

The costs developed by the Bridge Department for the Powder River Bridge in the Terry E & W Route Report have been used in this supplement. A discrepancy exists between the 1959 report and the Terry E & W report for this item. The structure used in the Terry E & W Report is approximately 300 feet shorter than that used in the 1959 report. The difference in costof the two structures is approcimately $490,000. This difference in cost does not affect relative costs since a common structure has been used in both cases.

The costs developed by the Bridge Department for the Line "B-1" bridge are correlated to the Terry E & W structure and reflect the additional costs required for channel alterations.

Sub-Base Construction

The same unit costs for grading have been used in this report as in the 1959 report. The higher unit cost on Line "A" through the valley was terminated near Blatchford and the Line B unit cost used to the East Common Point. The grade raises to accommodate access pipes on Line A, caused the major change in grading quantities.

Interchanges

An interchange will be required for both lines near the West Common Point. The 14' x 20' concrete box used for the Line "B" interchange in the 1959 report is now sub-standard and has been replaced by a structure. As previously mentioned, the Line "B" interchange near the East Common Point has been deleted.

Guardrail and Fencing

The same unit costs have been applied to guardrail. The fencing costs have been increased from $3,000 per mile to $6,000 per mile, in accordance with more recent cost experience.

Seed and Mulch

This item was not used in the 1959 report, but has been included in the supplement in accordance with our present practice.

Table No. 1, "Construction Costs", (p. 5) shows the initial and annual construction costs for Lines "A", "B" and "B-1".

This table shows the initial Line "A" costs to be $201,300 less than Line "B", and $318,800 less than Line "B-1".

The following is a table of the amortized construction costs for the 1959 report.

TABLE NO. 2

CONSTRUCTION COSTS

ITEM NO.		LIFE	6% CRF	"A" LINE TOTAL	"A" LINE ANNUAL	"B" LINE TOTAL	"B" LINE ANNUAL
1.	Right of Way	50	0.0634	127,320	8,072	30,250	1,918
2.	Structures	50	0.0634	1,046,400	66,342	1,043,650	66,167
3.	Grade and Drain	40	0.0665	1,299,016	86,385	1,842,887	122,552
4.	Base and Surface	20	0.0872	1,224,220	106,752	1,118,340	97,519
5.	Interchange (Complete)	30	0.0726	--		65,820	4,779
6.	Guardrail and Fencing	20	0.0872	52,886	4,612	98,372	8,578
7.	Utility Adjustments	40	0.0665	59,920	3,985	18,370	1,222
8.	Seed and Mulch	20	0.0872	--		--	
9.	Subtotal (Items 2-8)			3,682,442		4,187,439	
10.	Preliminary Engineering	40	0.0665	176,757	11,754	200,997	13,366
11.	Construction Engineering and Contingencies	40	0.0665	368,244	24,488	418,744	27,846
12.	TOTAL			4,354,763	312,390	4,837,430	343,947

This table shows that the annual construction costs favored Line "A" by $31,557.

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TABLE NO. 1

CONSTRUCTION COSTS

ITEM NO.		LIFE	5% CRF	A LINE		B-1 LINE		B LINE	
				TOTAL	ANNUAL	TOTAL	ANNUAL	TOTAL	ANNUAL
1.	Right of Way (Composite)	40	0.0665	$ 358,800	$ 23,860	$ 202,800	$ 13,490	$ 204,000	$ 13,570
2.	Structures	50	0.0634	555,000	35,190	642,200	40,720	552,200	35,010
3.	Grade and Drain	40	0.0665	1,185,100	78,810	1,711,700	113,830	1,663,800	110,640
4.	Base and Surface	20	0.0872	1,224,600	106,780	1,105,700	96,420	1,118,700	97,550
5.	Interchange (Complete)	30	0.0726	101,800	7,390	98,000	7,110	98,000	7,110
6.	Guardrail and Fencing	20	0.0872	186,300	16,240	177,300	15,460	168,700	14,710
7.	Utility Adjustments	40	0.0665	96,100	6,390	23,900	1,590	54,500	3,620
8.	Seed and Mulch	20	0.0872	51,100	4,460	50,800	4,430	51,400	4,480
9.	Subtotal (Items 2-8)			3,400,000		3,809,600		3,707,300	
10.	Preliminary Engineering	40	0.0665	200,600	13,340	224,800	14,950	218,700	14,540
11.	Construction Engineering and Contingencies	40	0.0665	340,000	22,610	381,000	25,340	370,700	24,650
12.	TOTAL			$ 4,299,400	$315,070	$ 4,618,200	$ 333,340	$4,500,700	$ 325,880

OPERATING COSTS

The major differences in operating costs have occurred for the following reasons:

1. Increasing the average running speed for passenger cars from 49 mph to 56 mph. This is in accord with our more recent route reports.
2. Using a 3.5:1 conversion factor for converting trucks to equivalent cars.
3. The increase in the 20 year average traffic caused by the change in design year.

The following table shows the average annual operating costs for Lines "A", "B" and "C".

TABLE NO. 3

20 YEAR AVERAGE ANNUAL OPERATING COSTS

1978 ADT = 3475 (With 10% Trucks)
1978 Equivalent Car ADT = 4344

LINE	EQUIVALENT ADT	MILES	COST PER MILE	DAYS PER YEAR	ANNUAL COST
A	4344	17.05	$ .1022	365	$ 2,762,850
B	4344	17.14	.1022	365	2,777,440
B-1	4344	16.95	.1022	365	2,746,650

This table shows the Line "B-1" average annual operating costs to be $16,200 less than Line "A", and $30,790 less than Line "B".

MAINTENANCE COSTS

The following table shows the annual maintenance costs for Lines "A", "B" and "C".

TABLE NO. 4

MAINTENANCE COST

LINE	TYPE OF FACILITY	MILES TO MAINTAIN	ANNUAL COST PER MILE	ANNUAL COST
A	2-Lane Interstate	17.05	1500	$ 25,580
	Frontage Roads	3.1	250	780
	Interchange Ramps	0.8	1000	800
	TOTAL ANNUAL COST			$ 27,160
B	2-Lane Interstate	17.14	1500	$ 25,710
	Interchange Ramps	0.8	1000	800
	TOTAL ANNUAL COST			$ 26,510
B-1	2-Lane Interstate	16.95	1500	$ 25,430
	Interchange Ramps	0.8	1000	800
	TOTAL ANNUAL COST			$ 26,220

This table shows there is no significant differences in maintenance costs.

SUMMARY OF ANNUAL COSTS

ANNUAL COSTS

LINE	CONSTRUCTION COSTS	MAINTENANCE COSTS	OPERATING COSTS	TOTAL COSTS
A	$ 315,070	$ 27,160	$ 2,762,850	$ 3,105,080
B	325,880	26,510	2,777,440	3,129,830
B-1	333,340	26,220	2,746,650	3,106,210

This table shows the total annual Line "A" costs to be $24,750 less than Line "B", and $1,130 less than Line "B-1".

SERVICE TO THE HIGHWAY USER

The service afforded property owners on the south side of the proposed Line "A" has changed considerably with the exclusion of at-grade approaches. These people must use present US 10, left in place as a north frontage road, instead of having direct access to the Interstate. The main difference between the service provided by the alternates is that some out of direction travel via frontage roads on the south side of the Interstate will be required for several persons to gain access to the north frontage road on Line "A". These same persons would have direct access to the north frontage road on Lines "B" and "B-1".

COMPARISON OF ROUTES

A comparison of the annual construction costs of the original and revised Lines "A" and "B" show that the annual difference in favor of Line "A" has been reduced from $31,560 to $10,810. Although a substantial reduction in the annual construction cost difference between Lines "A" and "B" has occurred, a comparison of the total annual costs shows Line "A" to have a $24,750 advantage.

Line "B" will be excluded from further consideration due to the substantial difference between it and Line "A" or Line "B-1".

An analysis of the revised Line "A" and Line "B-1" shows the annual construction cost to favor Line "A" by $18,270, and the annual operation costs to favor Line "B-1" by $16,200. Based on the total annual difference of $1,130 between these two alternates, a review of other pertinent features is presented for consideration.

1. Line "A" will require approximately 150 acres of irrigated land for Interstate Right of Way, and will probably adversly affect abutting irrigated land through narrow sections of irrigation.

2. Line "B-1" stays above the irrigation canal and will not require the taking of any irrigated land.

3. Line "A" separates the irrigated lands and farm improvements from US 10 left in place as a north frontage road. Access to the frontage road would be by vehicle passes.

4. Line "B-1"separates the irrigated land and farm improvements from tne grazing land, but provides direct access to the north frontage road.

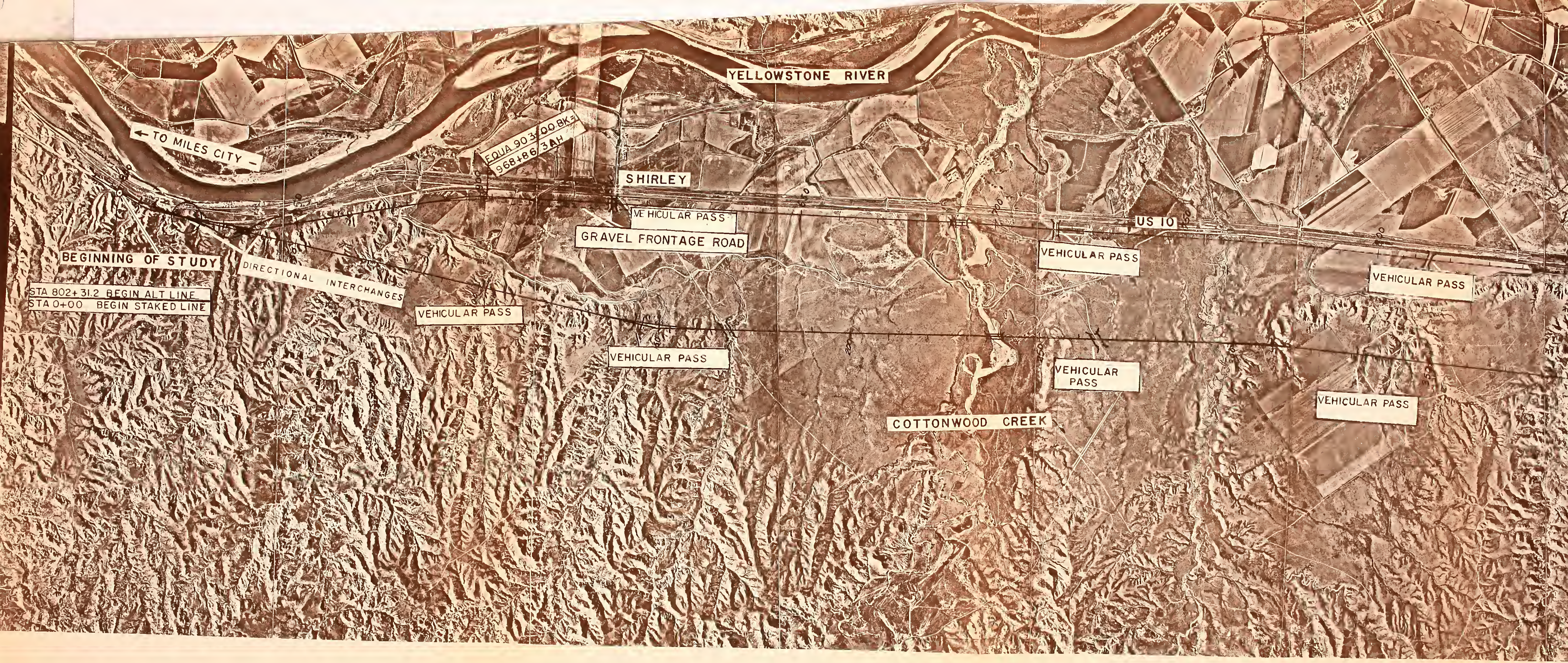
CONCLUSIONS

Line "B-1" is recommended to be advanced to construction for the following reasons:

1. The total annual costs are virtually the same on either route.

2. Line "B-1" provides better service to the land south of the Interstate.

3. Petitions from the area and testimoney at the Public Hearing favor a line outside the irrigated valley.


YELLOWSTONE RIVER
← TO MILES CITY –
EQUA 903+00 BK=
968+86 3AH
SHIRLEY
VEHICULAR PASS
GRAVEL FRONTAGE ROAD
US 10
BEGINNING OF STUDY
DIRECTIONAL INTERCHANGES
STA 802+31.2 BEGIN ALT LINE
STA 0+00 BEGIN STAKED LINE
VEHICULAR PASS
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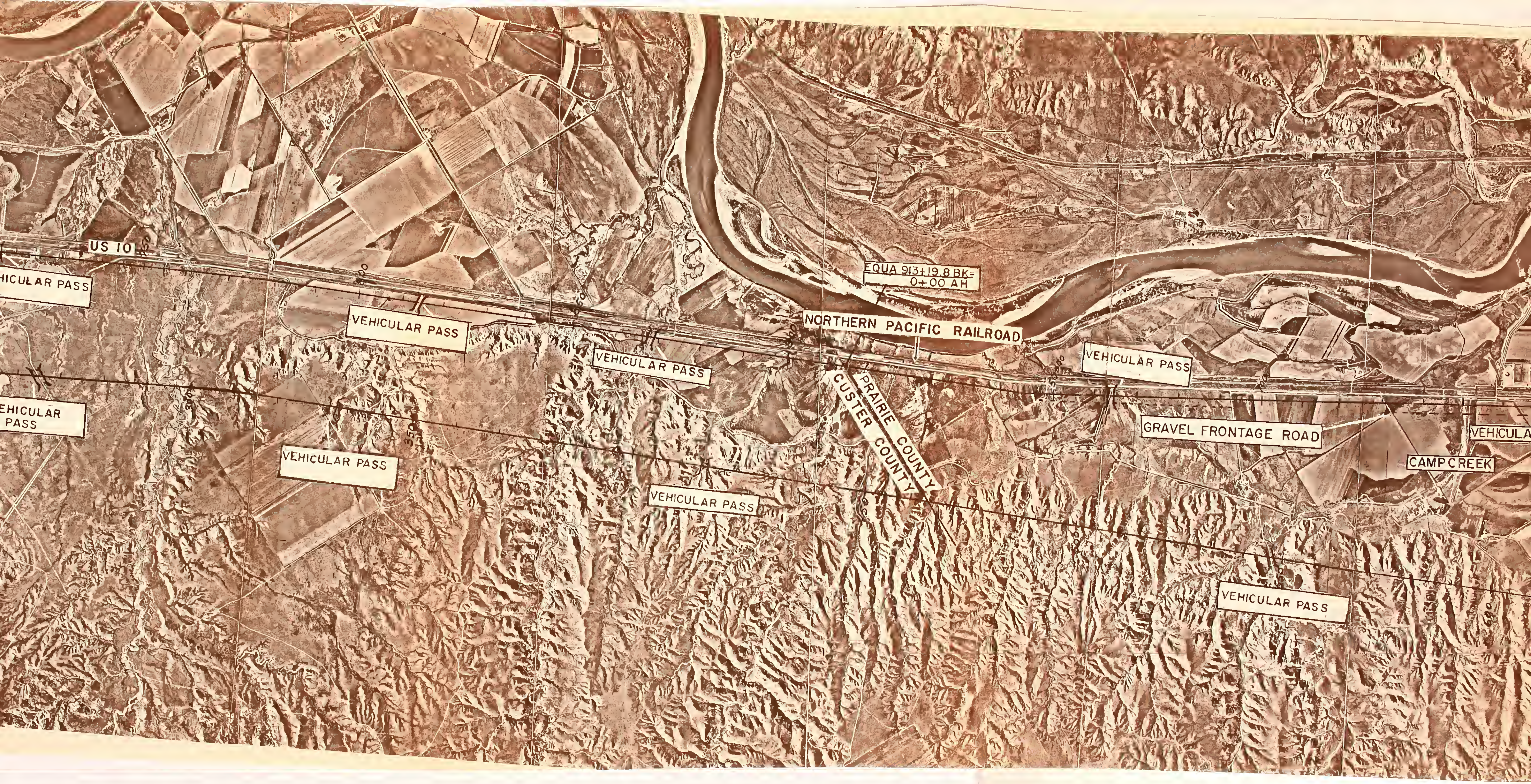
COTTONWOOD CREEK


US 10
HICULAR PASS
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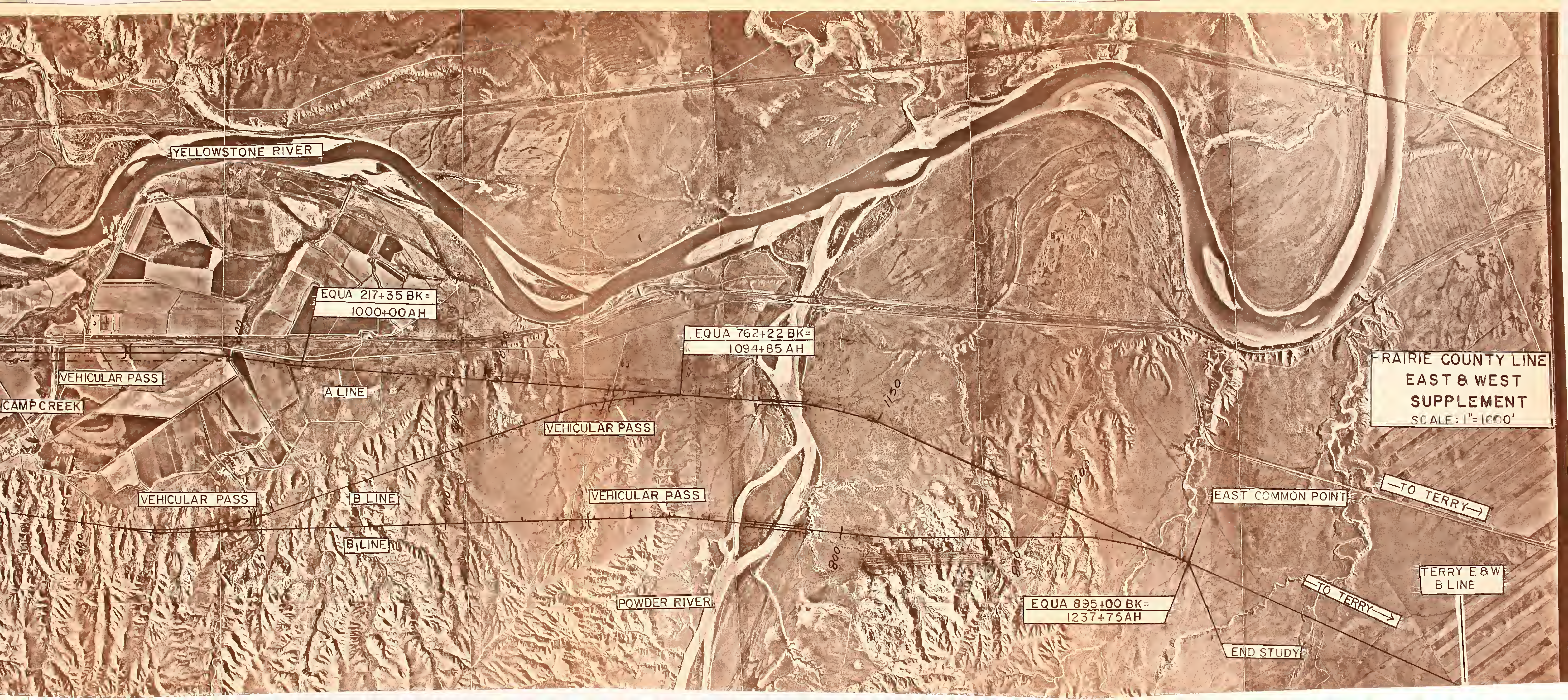
NORTHERN PACIFIC RAILROAD
PRAIRIE COUNTY
CUSTER COUNTY
VEHICULAR PASS
GRAVEL FRONTAGE ROAD
VEHICULA
CAMP CREEK
VEHICULAR PASS


YELLOWSTONE RIVER
EQUA 217+35 BK= 1000+00AH
EQUA 762+22 BK= 1094+85 AH
PRAIRIE COUNTY LINE EAST & WEST SUPPLEMENT SCALE: 1"=1600'
VEHICULAR PASS
CAMP CREEK
A LINE
VEHICULAR PASS
1150
VEHICULAR PASS
B LINE
VEHICULAR PASS
1200
EAST COMMON POINT
—TO TERRY→
700
650
B1 LINE
800
850
TERRY E&W B LINE
EQUA 895+00 BK= 1237+75AH
POWDER RIVER
—TO TERRY→
END STUDY